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IMPACT OF DENSE GNSS NETWORKS AND MULTI-GNSS ON TRANS-IONOSPHERIC RAY PATH DISTRIBUTION FOR TOMOGRAPHIC APPLICATIONS

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Abstract: The increasing number of GNSS (GPS, GLONASS, Galileo) satellites and ground receivers will in the next several years significantly increase the number of radio navigation signals probing the Earth's atmosphere. From these multiple observations, it is expected that a better monitoring and modeling of the ionosphere utilizing tomographic imaging will be possible.

In this study the added value of multi-GNSS in addition to GPS-only and dense networks in Belgium, France, Germany, UK and Scandinavia in addition to the EUREF Permanent Network (EPN) is investigated in terms of signal ray concentration traversing the Earth's atmosphere above Europe. The study is made using a tomographic approach: the Earth's atmosphere is divided into voxels.

First results, with a test grid of 1º in longitude by 1º in latitude by 100 km height during 30 minutes, show that the large EPN network is capable of insuring that 85% of voxels, in a zone extending from -10º to 35º in longitude and from 35º to 70º in latitude from 30 km to 1230 km, are traversed by GPS-only signals.

The additional dense receiver networks increase the total number of GPS signals. However the distribution of these additional ray paths creates inhomogeneity in the full set of observations because of the non-uniform distribution of the ground stations.

Finally, using the multi-GNSS leads to a geometric ray distribution which is more homogeneous in space and time. For our test grid, the percentage of voxels traversed by GNSS rays is 94%. From these results, we can expect to obtain better temporal and spatial resolution for ionospheric imaging.